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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

Ms. Magalie R. Salas
Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington, DC 20554

Re: WorldCom, Cox, and AT&T v. Verizon
CC Docket Nos. 00-218, 00-249, and 00-251

Dear Ms. Salas:

Enclosed are the responses of Verizon Virginia Inc. ("Verizon VA") to the record requests from the Commission for the first part of the cost hearings. Each responses is being offered as a separate exhibit. Thus, these responses are Verizon VA Exhibits 181 through 202.

Please note that the attachment to the response to VZ VA Record Request # 15 (Exhibit 195) contains proprietary information. Therefore, the public version of that response, which is being filed with the Commission, does not contain that proprietary attachment.

Please also note that the responses to VZ VA Record Requests #s 2, 10, and 21 (Exhibits 182, 190, and 201) contain large attachments; hard copies of these attachments are not being provided. Instead, Verizon VA is enclosing those attachments on CDs. Copies of this letter and the responses were served on the parties on the attached service list.

Please call if you have any questions.

Very truly yours,

Lynn R. Charytan

No. of Copies rec'd 0+7
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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of Petition of WorldCom, Inc. Pursuant to Section 252(e)(5) of the Communications Act for Expedited Preemption of the Jurisdiction of the Virginia State Corporation Commission Regarding Interconnection Disputes with Verizon Virginia Inc., and for Expedited Arbitration	)	CC Docket No. 00-218
In the Matter of Petition of Cox Virginia Telecom, Inc. Pursuant to Section 252(e)(5) of the Communications Act for Preemption of the Jurisdiction of the Virginia State Corporation Commission Regarding Interconnection Disputes with Verizon Virginia Inc. and for Arbitration	)	CC Docket No. 00-249
In the Matter of Petition of AT&T Communications of Virginia Inc., Pursuant to Section 252(e)(5) of the Communications Act for Preemption of the Jurisdiction of the Virginia Corporation Commission Regarding Interconnection Disputes With Verizon Virginia Inc.	)	CC Docket No. 00-251

CERTIFICATE OF SERVICE

I do hereby certify that true and accurate copies of Verizon Virginia Inc.'s responses to the Commission's First Set of Record Requests for the cost hearing were served electronically and by hand delivery this 10th day of December, 2001, to:

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Mark S. Morelli

VZ - VA
Exhibit No. 181

DOCKET FILE COPY ORIGINAL

Verizon Virginia Inc.

In Hearing Record Request

CC Docket Nos. 00-218, 00-249 and 00-251

FCC STAFF REQUEST OF:	Verizon Virginia (Transcript p. 3250)
DATED:	October 23, 2001
REQUEST:	Please place into the record relevant documents explaining how Dr. Hausman derives the 3.2-3.4 mark up factor, "m," used to account for the interaction of uncertainty with sunk investment cost.
RESPONSE:	The requested documents are attached. They are available only in hard copy and so are not being provided electronically.

VZ VA Record Request #1

Draft, August 14, 2000. Please do not circulate or quote without permission of the author.

Regulated Costs and Prices in Telecommunications

Jerry A. Hausman[1]

August 14, 2000

I. Introduction

Economic advice to regulators regarding the correct principles to set regulated prices has often been incorrect in that it does recognize the underlying technology of the industry. Economists recognized early on that in the situation of privately owned utilities in the United States that the first-best prescription of price set equal to marginal cost could not be used because of the substantial fixed (and common) costs that most regulated utilities needed to pay for.[2] This realization typically accompanied the claim that the economies of scale of the regulated firm were so significant that competition could not take place because the regulated firm's cost function was significantly below new entrants. Nevertheless, the most common advice from economists was that prices should be set similar to the outcome of a competitive process.

What the competitive process would be was never specified with any detail, which was to be expected since economic theory had no well-accepted model of competition with a technology exhibiting strong economies of scale, especially in the multi-product situation. In the U.S. regulators following legal principles adopted the position that the regulated firm should cover its costs. However, regulators also adopted prices for certain services to attempt to meet social goals for these given services. For other services, regulators used arbitrary means to set prices while balancing competing claims from increasingly well organized groups of consumers, all of whom claimed they should receive low prices with other groups paying for the fixed and common costs.

This regulatory approach arguably did not do undue damage when no actual competition existed. So long as the regulated firm was (nearly) productively efficient,

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[1] MacDonald Professor of Economics. I thank William Baumol for helpful discussions. Nina Tobio provided research assistance. Correspondence to jhausman@mit.edu.

[2] See e.g. A. Kahn, The Economics of Regulation, vol. 1, New York, 1970.

the losses were essentially second order social welfare losses.[3] The regulated firm covered its total costs, at least approximately, although prices for individual services were often badly distorted from an economically efficient solution.

However, when actual competition appeared and was allowed to exist by the regulators, the economists' advice of setting prices as if they were the outcome of a competitive process soon led to a regulatory morass. Regulators could no longer depend only on cost factors in setting regulated prices. The outcome of a competitive process would also need to take into account demand factors and competitive interaction (oligopoly) factors, with the first set of factors difficult to measure and the competitive interaction factors unlikely to be agreed upon. While regulators had some imperfect information about costs, they typically had little or no information about demand and no well-developed idea regarding the effects of competitive factors. In Sections II and III, I discuss under what conditions using costs to set regulation prices, while disregarding demand factors and competitive factors, is a reasonable economic policy.

A particularly difficult problem arose when a regulated firm wanted to decrease its prices for services subject to entrant competition. Economists recognized that price set above incremental (marginal) cost should be permitted. New entrants wanted the previously set regulator set prices to be maintained. New entrants typically entered because regulated prices were well above efficient levels, and the new entrants did not want these prices decreased. Furthermore, from a social welfare viewpoint the argument became first order since inefficient new firms could be productively inefficient causing a first order loss of social welfare.

Regulators found it difficult to permit the regulated firm to decrease its prices, especially since under cost of service regulation other prices would need to increase. Even when cost of service regulation was replaced by incentive (price-cap) regulation in the 1980s and 1990s, regulators still found it extremely difficult to allow price decreases since they believed in "regulated competition" (an oxymoron) where the regulators could better manage competition than the market. Nevertheless, the regulated companies were

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[3] However, the approach did harm consumers to a significant degree by retarding new product innovation, which is a first order loss to economic efficiency. See Hausman (1997) for estimates of consumer welfare loss.

not harmed too badly since competition did not proceed at such a rapid pace to cause extreme economic damage.

Cost based regulation of telecommunications (e.g. rate-of-return regulation in the U.S.) had significant negative effects on innovation while it was claimed that it led to excessive capital investment. Most economists conclude that cost based regulation led to significant consumer harm. In the mid-1980s when the UK government privatized British Telecom (BT), it decided not to use the historic approach of cost of service regulation to set regulated prices as the U.S. and Canadians had done. The UK government instead chose price caps, a new regulatory method proposed by Littlechild.[4] Price caps regulated prices based on inflation and a productivity factor instead of regulated profits as in the U.S. cost of service based "rate of return" (ROR) regulation.

Price caps had a number of advantages over ROR regulation in terms of incentives for cost minimization (productive efficiency), innovation, and the ability of the regulated firm to rebalance its prices. In particular, the regulated firm could decrease its prices to compete. In 1989-1990 the Federal Communications Commission, FCC, in the U.S. adopted price caps. Other countries such as Australia had also adopted price caps. During the 1980s and 1990s price cap regulation was implemented instead of cost-based regulation in most countries when telephone companies and other utilities were privatized. In the majority of the states of the United States, rate-of-return regulation has been replaced by price cap regulation. The battle to banish cost based regulation appeared to be largely over.[5]

During the late 1990s and the early 2000s cost based regulation has reappeared because of the necessity to set price for unbundled network elements sold by incumbent firms to their competitors. A number of governments, including the U.S., Australia, and Canada, adopted mandatory network unbundling for the incumbent local exchange carrier (ILEC). The most commonly used approach to set regulated network element prices

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[4] See Beesley and Littlechild (1989) for a description of the economic incentives under price caps.

based on costs is "total service long run incremental cost", or TSLRIC. Unfortunately, the adoption of TSLRIC as a cost basis to set the prices for unbundled elements has negative economic incentive effects for innovation and for new investment in telecommunications networks as I discuss in Section IV.

TSLRIC gives an incorrect basis to set regulated prices because it fails to recognize that s significant proportion of telecommunications networks are sunk costs. Instead, TSLRIC makes the assumptions that costs are fixed, but not sunk, so that the capital assets could be redeployed in other uses if technology advances or other economics events decrease the return on the assets. Failure by regulators to recognize the sunk cost character of much network investment leads to the grant of a free option to the competitors of the regulated incumbent. Causing the shareholders of the incumbent firm to fund the free option for the competition will lead to underinvestment by both the incumbent and the new competitors. The incumbent underinvests because it will not achieve (on average) a sufficient return to justify marginal investments due to the grant of the free option to its competitors. The new competitors, who receive the free option, will underinvest in facilities because of the subsidy they receive with the grant of the free option. Given the amount of uncertainty in a dynamic industry with rapidly changing technology and economics can have an especially large effect on investment incentives because the value of the option is high. The losers will be consumers and businesses who will not have access to the most up to date service that would be provided if regulatory did not create disincentives to new investment.

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[5] State regulatory agencies in the U.S. set local prices for telecommunications. California adopted price cap in 1989 and by the mid-1990s the majority of states had adopted some form of incentive regulation.

How did network unbundling and a return to cost based regulation become government policy? In 1996 the U.S. Congress passed the Telecommunications Act of 1996. As tradeoff for permitting local telephone companies to provide long distance, they agreed to unbundle their networks.[6] The FCC adopted cost of service regulation to set the unbundled network element prices. Thus, the well-known problems of cost of service regulation with its inability to correctly treat economies of scale and economies of scope and its use of arbitrary allocations of fixed and common costs to prices all reappeared. Even worse, the FCC adopted the approach of "total element long run incremental cost" (TELRIC) which assumes that all investments in telecommunications networks are fixed, but not sunk. This assumption is, of course, directly contradicted by the actual technology of telecommunications networks.

Perhaps an even more troubling development is that a number of countries such as the U.K. and Australia have adopted a similar incorrect regulatory cost based approach called "total service long run incremental cost", TSLRIC. It appears likely that the European Union (EU) will adopted a similarly incorrect approach. What is particularly troublesome is that the inventor of TSLRIC has now stated in a published paper that the failure to account for sunk costs is a mistake.

In this review paper I will discuss why the cost base approach to regulation, which ignores demand factors and competitive factors, is wrong except under a very special set of assumptions. See Section II and III. The assumptions, which are used in the "non-substitution theorem" and are closely connect to Marx's labor theory of value, would never hold true, even approximately in a real-world situation of telecommunications networks. Thus, the regulatory attempt to set prices independent of demand does not make economic sense.

However, even within this approach I next discuss in Section IV why the failure to take account of sunk costs, lead to a large downward bias in setting regulated prices.[7]

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[6] The Bell Operating Companies had been not allowed to provide interLATA long distance service since the breakup of AT&T in 1984.

[7] This section is based on my previous papers: J. Hausman, "Valuation and the Effect of Regulation on New Services in Telecommunications," Brookings Papers on Economic Activity: Microeconomics, 1997; "Regulation by TSLRIC: Economic Effects on Investment and Innovation," Multimedia Und Recht, 1999; and "The Effect of Sunk

The assumption that network investments are fixed, but not sunk, leads to a large error. Also, by giving a "free option" to new entrants the policy creates an economic disincentive for facilities based investment by the new entrants. Instead, they find it better to accept the below cost use of the incumbent providers network. Thus, regulators' attempt to set price that would occur in a competitive market is very far removed from the real world technology and competition that would exist in a competitive telecommunications market. FCC type regulation is leading to reduced economic efficiency and decreased consumer welfare. Instead, the regulators should permit actual competition to occur rather than trying to choose the form of "regulated competition" they think should take place.

In the last section of this review paper, Section V, I consider the question of which elements of the incumbents network should be subject to mandatory unbundling.[8] The goal of the U.S. Telecommunications Act is increased consumer welfare and increased competition. Thus, I discuss a consumer welfare approach to mandatory unbundling. This approach is in contrast to the U.S. regulators' approach of a competitor welfare standard. A competitor welfare approach will lead to reduced investment and innovation compared to a consumer welfare approach. The likely outcome of government policy in the U.S., in contrast to the approach taken in Canada and Australia, will be to harm U.S. consumers.

II. The Simple Model of Cost Based Regulation

The model of cost based regulation is to use costs of production to set prices that would be the result of a "competitive" situation. These costs of production are used to set prices independent of demand factors. A very simple one good-one period Marshallian partial equilibrium model leads to the result, where competitive price are independent of demand. I first describe this simple model and its inherent limitations.

Costs in Telecommunication Regulation," in J. Alleman and E. Noam, eds, The New Investment Theory of Real Options and its Implications for Telecommunications Economics, 1999.

[8] This section of the paper is based on J. Hausman and J. G. Sidak, "A Consumer-Welfare Approach to the Mandatory Unbundling of Telecommunications Networks," Yale Law Journal, 109, 1999.

A. Conditions for Prices Independent of Demand

Assume that a given regulated telecommunications service is produced by one or more input factors. No multi-period capital goods are present. The production technology exhibits constant returns to scale. In Figure 1 the result follows that the competitive price equal marginal cost which in turns equals average cost, because of the constant returns to scale assumption. As can be seen, the position and shape of the demand curve does not matter in setting the competitive price. Under these conditions, cost determines price, independent of demand. This interesting result depends very much on the assumptions of the economic model: partial equilibrium so that demand for the product does not affect input factor prices, constant returns to scale so there are no economies of scale, a single product so there is no joint production and no economies of scope, and a single period so there are no durable capital goods. I discuss later what happens when these assumptions do not hold. If any of the assumptions fails, the competitive price cannot be based on cost, independent of demand. Thus, the price independent of demand result will turn out to be a very special result not applicable to the real world of telecommunications.

B. The Role of Fixed Costs and Economies of Scale

I will now generalize this model slightly. Suppose that marginal cost remain constant but that I allow for a fixed cost of production. However, a single service is still being produced. The cost function can be written as:

$$C(q,w) = F + wq \qquad (2.1)$$

where F is the fixed cost, q is output quantity, and w is the constant marginal cost per unit of output. A regulator might conclude that in a competitive, free entry situation that price would equal average cost, so that $p = (C/q) = (F/q) + w$. Since quantity demanded is a function of price, price is no longer independent of demand. However, setting price equal to average cost, AVC, seems to be the correct outcome if the regulated utility is going to recover its costs.

C. The Role of Common Costs and Economies of Scope

Now I consider common costs. A common cost arises when two (or more) services arise from a joint production process, but some of the cost is incremental to neither product. The term "fixed and common costs" arises often in discussion of regulated costs and prices because of the common occurrence of this type of cost. In terms of the cost function I will again assume constant marginal costs for each output:

$$C(q_1, q_2; w_1, w_2) = G + w_1 q_1 + w_2 q_2 \qquad (2.2)$$

Note that in equation (2) the fixed cost G cannot be uniquely assigned to either output. Indeed, no measure of average costs for either output exists. Here regulators typically choose to use an allocation of the fixed cost G to each service. However, these allocations such as "fully allocated cost", "equal allocation of cost" and so on are inherently arbitrary.[9] Nevertheless, the results of the allocations have very important consequences on the regulated prices. These regulated prices in turn have important effects on competition, economic efficiency, and consumer welfare.

In competitive markets, firms set price based on cost conditions, demand conditions and competitive conditions. Regulators attempt to base prices on only the first of these three factors. Thus, regulators do not meet their goal of setting regulated prices in a similar manner that competitive market do. Furthermore, they cause billions of dollars per year of losses in economic efficiency and consumer welfare.[10] Instead of using inherently arbitrary allocation procedures, regulators should either take account of demand and competitive conditions in setting regulated prices or adopt procedures such

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[9] Indeed, the results of the allocations are depend in important ways on the units that the outputs, q_1 and q_2 are measured in.

[10] For an example of regulators causing losses of billions of dollars per year in economic efficiency and consumer welfare see J. Hausman, "Taxation By Telecommunications Regulation," Tax Policy and the Economy, 12, 1998 and J. Hausman and H. Shelanski, "Economic Welfare and Telecommunications Welfare: The E-Rate Policy for Universal Service Subsidies," Yale Journal on Regulation , 1999

as global price caps which will lead the regulated utility to take account of demand and competitive conditions.[11]

D. The Role of Sunk Costs

I now generalize the model one step more by consider sunk costs in addition to fixed costs. Sunk costs are costs that cannot be recovered if the economic activity ceases. Sunk costs are prevalent in telecommunications networks: consider an investment in a (copper) loop to a residential customer. The customer has a unique loop that connects the residence to the central office switch. If the customer decides to use a competitive service, e.g. local access service offered by a competitive cable company or by a wireless company, the copper loop cannot be redeployed in another service. The investment in the loop is sunk. Now if a regulated telephone company faced no uncertainty over the future use of the loop and the cost and prices for the associated services provided with the loop, the distinction between a fixed cost, which arises from an asset which can be economically redeployed, and a sunk cost is not that important.

Indeed, in the "old days" of cost based regulation for a monopoly provider if an investment were deemed to be "used and useful" by the regulator, the asset entered the regulatory cost base. Once the asset entered the regulatory cost base, the regulator, in principle, allowed the utility to recover the cost of the investment.[12]

However, in the current situation of competition, where the utilities competitors are allowed to use the incumbent's network at regulated prices, the distinction between fixed costs and sunk costs can be quite important. The competitor typically pays for the facility it uses on a monthly basis. As I explain below regulators universally use an approach which assumes that the investment costs are fixed but not sunk. In setting the regulated prices without taking into account the interaction of sunk costs and uncertainty, regulators give competitors a "free option" to use the incumbent's network with requiring a price that takes account of the sunk cost nature of much of the investment. The regulators thus subsidize the competitors at the expense of the incumbent and create an

[11] See Laffont and Tirole (2000) for a discussion of global price caps.
[12] In practice, because of incorrect depreciation schedules and inflation, utilities often did not recover the true cost of their investments.

economic disincentive fore the competitors to invest in their own competing facilities.[13] Furthermore, the regulators decrease the incentive for new services offered by the incumbent. New services often fail. Yet if successful new services must be resold to competitors at cost, the incentive to undertake the required risky investment is decreased.[14] Thus, regulators are likely to decrease new service for consumers based on their approach to setting regulated prices.

III. Cost-Based Regulation: Economic Analysis with Cost but Not Demand

As I discussed above, in a simple one period and one good production model with constant returns to scale a partial equilibrium Marshallian analysis demonstrates that the competitive price does not depend on demand. Marginal cost and average cost are independent of quantity produced so the position of the demand curve does not affect the price as demonstrated in Figure 1. However, the required description of technology does not describe accurately almost any industry in a modern industrial economy and certainly not the telecommunications industry. For example, telephone and wireless networks have a very large proportion of fixed and sunk costs. I now consider if the "price independent of demand" type result holds in a broader context to see if it is (approximately) applicable to telecommunications.

To do so I consider "non-substitution" theorems, which demonstrate that under certain conditions an economy will have a unique price structure determined by the costs of production, independent of the structure of final demand. I will refer to these results as Samuelson-Mirrlees non-substitution theorems.[15] I consider initially the simplest situation where labor is the only non-produced factor in the economy. Here a set of

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[13] Justice Stephen Breyer of the U.S. Supreme Court in a recent decision, *AT&T Corp. v. Iowa Utilities Board,* 119 S. Ct. 721 (1999), described how this outcome distorts and decreases the actual amount of competition. Regulators are actually causing decreased competition when one of their stated goals is to increase competition.

[14] For estimates of the extremely large gain to consumer welfare that can arise from new telecommunications services see J. Hausman, "Valuation and the Effect of Regulation on New Services in Telecommunications," Brookings Papers on Economic Activity: Microeconomics, 1997.

[15] See Samuelson (1961) and Mirrlees (1969). An early version of this type of result is in Georgescu-Roegen (1951). A textbook treatment is found in Bliss (1975, Ch. 11).

necessary conditions that would lead to a Samuelson-Mirrlees non-substitution theorem result:

Necessary Conditions for a non-substitution theorem:

1. Only one non-produced good exists: the good is usually assumed to be labor so that land or minerals do not exist.
2. The technology is constant returns to scale: a constant per unit requirement of inputs occurs regardless of the amount of output. This condition rules out economies of scale.
3. No joint production: a single production process cannot lead to two or more different outputs. This condition rules out economies of scope.
4. The economy is productive: the economy can produce a positive net vector of outputs where net output is gross output minus inputs.

With these (plus some additional technical) conditions, the product prices will be independent of final demand. The product prices will equal the cost of production, denominated in terms of the numeraire which can be units the non-produced good. Thus, in a Samuelson-Mirrlees non-substitution model, prices of the many products in the economy are independent of demand as in the simple partial equilibirum single-product Marshallian model

B. Enter the Marxian Theory of Value

Since labor was the only primary input in the economy described by the non-substitution theorems and prices are independent of demand, what sets the price? Prices are set by the cost of production, as in the Marshallian example, and the cost of production is the sum of direct plus indirect labor costs in a one-period economy.[16] Actually, solving the dual problem to the linear programming problem which minimizes the cost for a given final output vector that yields the non-substitution theorem result leads to the conclusion that the labor costs will be minimized in the problem. These minimized costs establish the prices in the non-substitution theorem economy and

[16] Indirect labor costs are "embedded" in the other commodity inputs used to produce a given output.

independent of final demand. This result is similar to the Marxian labor theory of value.[17]

When the situation is generalized to more than one period and durable capital goods are present, the cost of production remains direct plus indirect labor costs. However, the labor costs that are embedded in the durable capital goods increase at the economy-wide rate of interest, connected to the steady-state growth rate of the economy, each period.

It is worth noting that I have used the terminology "Marxian theory of value", not a "Marxian theory of price". The Marxian theory of value arises from the labor cost of production theory as discussed above in a particular multi-sector economic model. A huge literature exists that attempts to go from this labor theory of value to the competitive price in the context of Marxian analysis—the so-called transformation problem between values and competitive prices.[18] Marx understood that market determined competitive prices could differ greatly from the labor theory of value.[19] Furthermore, Marx and his followers were unsuccessful in solving the transformation problem except under very restrictive and uninteresting assumptions.

Thus, both Marx and his followers were unable to go from a cost basis in terms of labor costs to observed competitive prices (independent of demand). Cost based regulation is involved in a similar exercise to this "crude" Marxian economics of determining prices that would result in a competitive economy from some measure of cost, which is an impossible task under realistic economic conditions. But the regulators' attempt to set "competitive" prices while disregarding demand has some interesting connections with Marxian economic analysis. Regulators and some Marxian economists have attempted a remarkably similar yet mistaken approach to determine competitive prices from a basis determined solely by the costs of production.

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[17] See e.g. Morishima (1973).

[18] See Samuelson (1971) and Morishma (1973).

[19] I do not mean to initiate or bring back hoary, and now unimportant, debates about what Marx really meant. For the reader, please do not contact me about these interpretations for I will not answer.

C. Necessary Assumptions and Economic Reality: The "Regulatory Fallacy"

I now consider how realistic the necessary assumptions for the application of the non-substitution theorem are in the context of telecommunications. Could the regulatory goal of setting competitive prices independent of demand hold approximately true in an realistic economic situation? Since the assumption for the Samuelson-Mirrlees non-substitution theorems are necessary assumption, no weaker assumptions will do. Thus, to correctly set prices independent of demand the four necessary assumptions must hold true. The first assumption of only a single unproduced factor cannot be correct in a modern economy. If labor and land (minerals) are both unproduced factors their relative prices will affect input costs and final product prices. But their relative prices will depend on the pattern of demand for products that use both labor and land (silicon, copper, and silver). Since products will use in direct and indirect form different proportions of the nonproduced products, the relative prices cannot be independent of demand.[20] Then, neither the cost of production nor final product prices can be independent of demand. How important this departure from the necessary assumption is cannot be resolved easily. It may not be that important since if we consider telecommunications as a separable sector of the economy (somewhat similar to partial equilibrium analysis), it might be claimed that the sector is small enough compared to a given regional economy for service and the world economy for capital goods, that is does not have a significant effect on the relative prices of the primary factors. The price of the Hicksian composite economy for the non-telecommunications sector might then be used as a numeraire without too much departure from reality. I will similarly dispose of the last assumption that the economy is productive with the remark that as an approximation likely departure (if any) would likely be unimportant.[21]

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[20] Even if labor were the only primary factor, different qualities of labor (non-homogeneous labor) would receive different wages depending on demand conditions for the different human capital that different types of labor possessed. Again the necessary conditions for the non-substitution theorems would be violated. For a further discussion see Morishima (1973).

[21] Some environmental economists claim this assumption dos not hold when environmental "goods" are taken into account. I believe this claim is based on a fundamental misunderstanding of economics, but I do not belabor the point here.

I now turn to the two most important necessary assumptions for the current application: no economies of scale and no economies of scope. The presence of large economies of scale has traditionally been given as one of the primary reasons for regulation.[22] The old question of a "natural monopoly" is based on large economies of scale. Whether or not the claim of a natural monopoly is correct, modern telecommunications network regulation in the U.S., UK, Australia, and Canada is based on the importance of economies of scale.[23] The idea is that a new entrant cannot duplicate the telecommunications network so that the incumbent provider is required to sell the use of its network to the new entrant at a regulated cost. The common terminology of "fixed and common" costs in telecommunications denotes the importance of economies of scale that arise from the "fixed costs" in modern telecommunications networks. As I discuss later, the regulated price typically ignore demand factors which is inconsistent with the whole notion of economies of scale. The higher is demand the lower is per unit cost, especially when fixed costs are taken into account.[24]

The no economies of scope assumption of the Samuelson-Mirrlees non-substitution theorems is violated by all modern telecommunications networks. Economies of scope arise when it is less costly to produce two or more products jointly than by separate production processes. An example of joint production arises with modern telecommunications switches, which are combinations of computers and switch blocks.[25] Switches route calls but they also provide other services such as voice mail. The same computer is used to provide both services in a less costly manner than if switching and voice mail were provided separately. Again economies of scope are one of

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[22] See e.g. A.E. Kahn (1988), vol. II, pp. 119. ff.

[23] Economies of scale can often appear as economies of density in telecommunications, but the basic notion is the same.

[24] This statement may not hold in the U.S. in the future. The 8th Circuit Court of Appeals recently (July 2000) invalidated the FCC's approach to setting regulated prices for network elements. The Court of Appeals said that in the future regulated prices must depend on actual, not hypothetical, costs, The actual costs will depend on demand. The FCC will likely attempt to evade this requirement as they have done with prior Supreme Court and Appeals Court rulings, but the FCC's future success in evasion of court directions will remain uncertain.

[25] For a further discussion of economies of scope with switches see Hausman and Kohlberg (1989).

the stated reasons for required resale of network functions by incumbent telephone companies to their competitors. A further indication of the importance of economies of scope are the importance of "common costs" in debates over regulated prices. Common costs are typically defined to be costs that arise from two (or more) services but the costs are not incrementally caused by either service alone. The FCC, the Canadian CRTC, and some state regulatory bodies have arbitrarily set a markup to the "direct" cost of 20-25% to take account of common costs.

Yet economists know that most modern competitive companies have joint production and common costs for the production of their outputs. These competitive companies base their prices on competitive conditions for their products. Competitive conditions take account of demand conditions that arise from overall market demand for the product as well as firm demand conditions that arise as a result of competition. While regulators often say they want to replicate the outcome of a competitive process, they miss the obvious point that a competitive process involves cost factors as well as demand factors. Regulators, to the contrary, ignore the effect of demand factors on competitive outcomes. Instead, regulators use arbitrary markups over some measure of incremental (or variable) cost to account of economies of scale and economies of scope. These arbitrary markups decrease economic efficiency and consumer welfare significantly.

An additional necessary assumption for a non-substitution theorem to hold is that the economy is on a steady state growth path. This assumption allows for durable capital goods to enter the model. This assumption for an economy may be a reasonable approximation in certain circumstances, but for the telecommunications sector is departs from any approximation to economic reality.[26] Economists agree that the telecommunications sectors is among the most dynamic in the economy. And since the durable capital goods used in the telecommunications sector are closely connected to semiconductors and optical transmission, innovations in these sectors will directly affect investment in capital goods in telecommunications. Thus, the steady-state growth assumption is not a good assumption for telecommunications.

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[26] Burmesiter (1980) emphasizes the unreality of the steady-state growth assumption within labor theory of value models.

Thus, my evaluation is that modern telecommunications differ in many significant and quantitatively important ways from the necessary conditions for price to be independent of demand. Economies of scale and economies of scope are universally recognized to be important economic characteristics of modern telecommunications networks. The regulatory attempt to set prices as if they were the outcome of a competitive process but to ignore the importance of demand factors leads to what I call the "*regulatory fallacy*." No serious student of economics would claim that the necessary conditions for the non-substitution theorem hold in a telecommunication network environment. Yet the regulatory assumption that price would be based on cost alone in a competitive market is wrong. Economic theory has developed precise condition when price is independent of demand, and they do not hold, even as an approximation, in telecommunications. Thus regulators are acting on an erroneous belief that with competition that price equals cost, independent of demand. This erroneous belief leads directly to the resulting regulatory fallacy. The consequent use of arbitrary allocations and markups to regulated prices to take account of "fixed and common costs" which are *exactly the costs that arise from economies of scale and scope* leads to significant consumers harm. If regulators instead took account of demand factors in setting regulated prices, economic efficiency and consumer welfare could be increased significantly.[27]

IV. Fixed and Sunk Costs in Cost-Based Regulation

A. Current FCC Approach to Regulation of Unbundled Elements

The U.S. Congress passed the Telecommunications Act of 1996, which called for less regulation, more competition, and the most modern up to date telecommunications infrastructure: "...[T]o provide for a pro-competitive, de-regulatory national policy

[27] For a recent situation where the FCC disregarded demand conditions and caused billions of dollars in efficiency losses to the economy see Hausman (1998a). I

framework designed to accelerate rapidly private sector deployment of advanced telecommunications and information technologies and services to all Americans by opening all telecommunications markets to competition".[28] The Federal Communications Commission (FCC) has instituted numerous regulatory rulemakings to implement the 1996 Telecommunication Act. The most important regulations so far have been the Local Competition and Interconnection Order of August 1996.[29] If implemented in its current form, the Local Competition and Interconnection Order will likely have serious negative effects on innovation and new investment in the local telephone network.[30]

First, I consider the proper goal of regulation set prices in telecommunications. Most economists agree that regulation should be used only when significant market power can lead to unregulated prices well above competitive levels.[31] The goal of

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demonstrate that if demand conditions had been taken into account, the efficiency looses to the economy could be reduced to approximately zero.

28. Conference Report to the Telecommunications Act of 1996, Pub. L. No. 104–104, 110 Stat. 56.

[29] FCC, "First Report and Order, CC docket No. 96-98 and 95-185", August 1, 1996.

30. The FCC is being challenged by the incumbent local exchange carriers (ILECs) in Federal Court. The U.S. Supreme Court reversed and remanded for further consideration the FCC's regulatory approach in January 1999. See AT&T Corp. *v.* Iowa Utils. Bd., 119 S. Ct. 721 (1999). The key issue remanded to the FCC was what network elements should be unbundled. Justice Breyer in his separate opinion discussed the effect of the FCC approach to prices of unbundled elements and the likely negative effect on new investment and innovation in local networks, which is the subject of this paper. In July 2000 the 8th Circuit Court of Appeals invalidated the FCC approach of basing it cost estimates on a hypothetical network, rather the actual network in use. See Iowa Utils. Bd. v. FCC, No. 96-3321, (2000). The Court decision requires the FCC to modify its approach to cost estimation.

[31] In considering the regulation of unbundled elements, the FCC has failed to consider whether in the absence of regulation market power could be exercised by the ILECs.

regulators is then to set prices at "competitive levels". However, economists are much less explicit about how these competitive levels of prices can be estimated. Most economists would agree that perfect competition cannot yield the appropriate standard since prices set at marginal cost will not allow a privately owned utility to earn a sufficient return on capital to survive. The large fixed costs of telecommunications networks thus do not allow the price equal marginal cost standard of perfect competition to be used.[32]

An alternative competitive standard has been proposed by William Baumol and his co-author, the "perfect contestability" standard. Baumol has proposed that the regulators should require firms to set prices as if "the competitive pressures generated by fully unimpeded and costless entry and exit, contrary to fact, were to prevail."[33] However, costless entry and exit presumes that no sunk costs exist, i.e. costs that cannot be recovered upon exit by a firm.[34] This assumption of no sunk costs is extremely far from

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Instead, the FCC has adopted a "competitor welfare standard", which is inconsistent with the economic analysis of competition and the modern antitrust law. I discuss this problem in Section V of this paper. In contrast, Canadian regulators have take competitive considerations into account in their decision on which elements should be unbundled. Hausman and Tardiff (1995) discuss competitive considerations in unbundling.

[32] Economists have long agreed on this point. See e.g. Kahn (1988) for a discussion.

[33] Baumol and Sidak (1994), p. 28 and pp. 31 ff.

[34] See e.g. the FTC and DOJ Horizontal Merger Guidelines (1992) define a sunk cost as an "asset that cannot be recovered through the redeployment of the asset outside the relevant market, i.e. costs uniquely incurred to supply the relevant product and geographic market." (¶ 1.32)

economic and technological reality in telecommunications where the essence of most investments is an extremely high proportion of sunk costs.

Consider the investment by an incumbent local exchange carrier (ILEC) in a new local fiber optic network which can provide new broadband services and high speed internet access to residential customers. Most of the investment is sunk since if the broadband network does not succeed, the investment cannot be recovered. Thus, when either technological or economic uncertainty exists "perfect contestability as a generalization of perfect competition" cannot provide the correct competitive standard.

In a perfectly contestable market, if the return to an investment decreases below the competitive return, the investment is immediately removed from the market and used elsewhere. This costless exit strategy is always available in a perfectly contestable market.[35] However, the actual economics of telecommunications investment could not be further from a perfectly contestable market. When fiber optic networks are constructed, they are in large part sunk investments.[36] If their economic return falls below competitive levels, the firm cannot shift them to other uses because of their sunk and

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[35] To the extent that some network elements are fixed, but not sunk, investments they should not be unbundled by regulators since new entrants can enter and exit markets using these elements without undergoing sunk investments, which can create entry (and exit) barriers.

[36] The electronic used in the networks need not be sunk, but much of the actual dark fiber will be a sunk investment.

irreversible nature.[37] Thus, the use of a perfectly contestable market standard fails to recognize the important feature of sunk and irreversible investments--they eliminate costless exit. Because of its failure to take into account the sunk and irreversible nature of much telecommunications investment, the contestable market model has nothing of interest to say about competition in telecommunications.[38] An industry cannot be expected to behave in a manner that is fundamentally inconsistent with its underlying technological and economic characteristics.

One way to consider the problem is the situation of a new investment by an ILEC. Suppose a competitor wants to buy the unbundled elements associated with the investment. The ILEC could offer the new competitor a contract for the economic life of the investment—say 10 years for investment in the local loop. The price of the unbundled element would be the total investment cost plus the operating costs each year for the unbundled element. If demand did not materialize or prices fell, the new entrant would bear the economic risk of this outcome.[39] However, regulation by total service long run incremental cost (TSLRIC) typically allows the new entrant to buy the use of the

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37. This feature of sunk and irreversible investment has been widely recognized by economic research for over a decade. See MacDonald and Siegel (1986) and for a recent comprehensive textbook treatment see Dixit and Pindyck (1994).

[38] The contestable model of competition has been highly criticized as relating to real world situations. Previous criticisms of its attempted application to telecommunications include Armstrong and Vickers (1995), "In fact, of course, the industry does not remotely resemble a contestable market..."

[39] The contract (or regulation) could allow the new entrant to sell the use of the unbundled element to another firm if it decided to exit the business.

unbundled element on a month-by-month basis. Thus if demand does not materialize or prices fall, the ILEC has to bear the risk for the business case of the new competitor. Thus, the ILEC has been required by regulation to give a free option to the new entrant, where an option is the right but not the obligation to purchase the use of the unbundled elements. The monthly price of the unbundled element should be significantly higher than the ten year price of the element to reflect the risk inherent in the sunk investments, or equivalently the value of the option given to the new entrant.[40] Regulators to date, including the FCC, the ACCC in Australia, and the European Union have not incorporated the value of the option, which arises from the sunk cost nature of much telecommunication investment, into their price setting.

Another way to consider the problem of regulation set prices is to allow for the existence of the (all-knowing) social planner. Suppose the social planner were considering a new investment in a telecommunications network where the features of sunk and irreversible investments is important. The social planner wants to maximize the value of the social welfare integral over time subject to uncertainty. However, the investment is subject to both technological and economic uncertainty so that the cost of the investment may (randomly) decrease in the future and because of demand uncertainty the social planner does not know whether the investment will be economic. In making an

[40] In contracts between unregulated telecommunications companies, e.g. long distance

optimal decision the social planner will take into account the sunk and irreversible nature of the investment since if the new service fails, the investment cannot be shifted to another use. Thus, incorrectly assuming that sunk costs do not exist, which is the perfect contestability standard, when sunk costs are an extremely important part of the economic problem will lead to incorrect decisions and decreased economic efficiency. The economy will not reach its production possibility frontier.

B. Regulation Set Prices for Unbundled Elements

Under the Telecommunication Act of 1996 the FCC mandated forward looking cost based prices for competitors to use unbundled LEC facilities.[41] The FCC did not permit any markup over cost to allow for the risk associated with investment in sunk assets; instead, it used a total service long run incremental cost (TSLRIC) type approach that attempts to estimate the total service long run incremental cost on a forward looking basis.[42] Australia and European regulators have chosen a similar approach. TSLRIC attempts to solve the perfect competition problem that price cannot equal marginal cost by allowing for the fixed costs of a given service to be recovered. TSLRIC allows for

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carriers, and their customers, significant discounts are given for multi-year contracts.
41. The FCC decision is currently under court appeal by the ILECs. In the FCC proceeding I provided testimony on behalf of the ILECs. See Hausman (1996).
42. The FCC chose a variant of TSLRIC, called TELRIC for total element LRIC. However, the essential economic problem of TSLRIC also exists in TELRIC. The FCC is currently constructing a TELRIC model to be used in future regulatory proceedings.

recovery of the cost of investment and variable costs of providing the service over the economic lifetime of the investment. However, TSLRIC makes no allowance for the sunk and irreversible nature of telecommunications investment, so that it adopts the perfect contestability standard. The perfect contestability standard provides the incorrect economic incentives for efficient investment once technological and economic uncertainty exist. The FCC and other regulators have chosen the incorrect standard for setting regulated prices. TSLRIC will lead to less innovation and decreased investment below economically efficient levels.[43]

C. The TSLRIC Standard and Harm to Innovation

The first and easiest example to consider is R&D and investment in new services. Many new telecommunications services do not succeed, as recent failures include Picturephone services (AT&T and MCI within the past ten years) and information service gateway services offered by many ILECs. These new gateway services required substantial sunk costs of development because creation of the large data bases to provide information service gateways is substantial. Now if a new service is successful, under TSLRIC regulation, an ILEC competitor can buy the service at TSLRIC. Thus, for a

[43] TSLRIC would provide the correct approach in a world with no uncertainty so long as economic depreciation was done correctly. However, given the dynamic technological advances in telecommunications, considerable uncertainty exists, especially over the long economic lifetimes of much investment in telecommunications.